

## Claims:

1. A rotary screw machine of volume type comprising a body (30) having a main axis X, two members consisting of a male member (10; 110; 500; 600; 700) and a female member (20; 120; 600; 700; 800) surrounding said male member, wherein an outer surface of the male member (10; 110; 500; 600; 700) defines a male surface (12; 112) and an inner surface of the female member defines a female surface (22; 122), said male (12; 112) and female (22; 122) surfaces being helical surfaces having respective axes  $X_m$  and  $X_f$  that are parallel and spaced apart by a length E, said male (12; 112) and female (22; 122) surfaces defining at least one working chamber (11) by formation of linear contacts (A1, A2, A3) of said male (12; 112) and female (22; 122) surfaces and relative displacement of said male (10; 110; 500; 600; 700) and female (20; 120; 600; 700; 800) members, said male (12; 112) and (22; 122) female surfaces being further defined about said axes  $X_m$  and  $X_f$  by a nominal profile in a cross section of the mechanism, said profile of the male surface (12; 112) defining a male profile (14; 114; 514; 614; 714) having an order of symmetry  $N_m$  with respect to a center  $O_m$  located on said male axis  $X_m$ , said profile of the female surface (22; 122) defining a female profile (24; 124; 624; 724; 824) having an order of symmetry  $N_f$  with respect to a center  $O_f$  located on said female axis  $X_f$ , said rotary screw machine further having a main synchronizing coupling comprising a crank like mechanism (32; 34; 48; 59) generating an eccentricity E between said main axis X and one of the axes ( $X_m$ ,  $X_f$ ),

characterized in that a first one of said male (10; 110; 500; 600; 700) and female (20; 120; 600; 700; 800) members is hinged in said body (30) and is able to rotate on itself about its fixed axis ( $X_m$ ;  $X_f$ ) according to a rotational motion,

in that said crank like mechanism (32; 34; 48; 59) is connected to a second one of said male (10; 110; 500; 600; 700) and female (20; 120; 600; 700; 800) members to allow the axis ( $X_f$ ;  $X_m$ ) of said second member to revolve about the fixed axis of said first member ( $X_m$ ;  $X_f$ ) according to an orbital revolution motion having said length E as a radius, and

in that said rotary screw machine comprises a main synchronizer (34, 40, 36, 38; 44, 46, 48; 54, 56; 58;) synchronising said swiveling motion and said orbital revolution motion, one with respect to the other, so that said male (12; 112) and female (22; 122) surfaces mesh together.

2. A rotary screw machine according to claim 1, characterized in that it further comprises rotational transmission means (31; 131) connected to said crank organ (32; 59) or to said first member (10; 110; 500; 600; 700; 20; 120; 600; 700; 800).

3. A rotary screw machine according to claim 2, characterized in that said rotational transmission means (131) is a two-channel rotational means (131).

4. A rotary screw machine according to anyone of the preceding claims, characterized in that said male (12; 112) and female (22; 122) surfaces are brought in mechanical contact forming a kinematic pair allowing the transmission of motion between said first (10; 110; 500; 600; 700) and second (20; 120; 600; 700; 800) members.

5. A rotary screw machine according to anyone of the preceding claims, characterized in that it further comprises an additional synchronizer (50, 52), linked to said body and allowing said second member (20; 120; 600; 700; 800; 10; 110; 500; 600; 700) to rotate about its axis.

6. A rotary screw machine according to claim 5, characterized in that said additional synchronizer comprises a planetary gear transmission (50, 52).

7. A rotary screw machine according to anyone of claims 5 to 6, characterized in that it further comprises rotational transmission means (31; 131) connected to said crank organ (32; 34; 48; 59) and to one of said male (10; 110; 500; 600; 700) or female (20; 120; 600; 700; 800) member.

8. A rotary screw machine according to anyone of the preceding claims, characterized in that said synchroniser further comprises a kinematical coupling mechanism (40, 36, 38; 44, 46, 48) of both members (10; 500; 600; 700; 20; 600; 700; 800) together, said kinematical coupling comprising at least one coupling organ (36; 46), which is hinged in said body (30).

9. A rotary screw machine according to claim 8, characterized in that said kinematical coupling mechanism comprises a gear transmission (40, 36, 38; 44, 46, 48).

10. A rotary screw machine according to anyone of preceding claims, characterized in that said synchronizer comprises a planetary gear transmission (54, 56).

11. A rotary screw machine according to anyone of preceding claims, characterized in that said synchronizer comprises an inverter (58).

12. A rotary screw machine according to anyone of preceding claims, characterized in that said synchronizer comprises a coulisse mechanism (59, 60, 61).

13. A rotary screw machine according to anyone of the preceding claims, characterized in that it further comprises at least one additional male and female members (500; 600; 700; 600; 700; 800) disposed in line with said male and female members.

14. A rotary screw machine according to anyone of the preceding claims, characterized in that it further comprises at least a third member disposed inside or surrounding said male and female members (500; 600; 700; 600; 700; 800), in such a way that their surfaces are in mechanical contact so as to form additional chambers (11).

15. A rotary screw machine according to anyone of the preceding claims, characterized in that said female order of symmetry  $N_f$  is equal to  $N_m - 1$ .

16. A rotary screw machine according to anyone of claims 1 to 14, characterized in that said female order of symmetry  $N_f$  is equal to  $N_m + 1$ .

17. A rotary screw machine according to anyone of the preceding claims, characterized in that said male and female surfaces can degenerate into cylindrical surfaces.

18. A method of transforming a motion in a volume screw machine, which comprises:

(a) creation of an interconnected motion of screw conjugated elements in the form of male and female members and links of synchronizing coupling with the help of converted positive flows of mechanical energy and working substance energy in working chambers of said volume screw machine;

- (b) driving one of male or female member into a planetary motion with two degrees of freedom of mechanical rotation one of which being an independent degree of freedom relative to the fixed central axis of the other member;
- (c) transmission of said positive energy flows of conversion through an independent degree of freedom of mechanical rotation of said machine.

19. The method according to claim 18, in which it provides the creation of a differentially connected motion of male and female members and links of synchronizing coupling with a second independent degree of freedom of a rotary motion and the transmission of the positive energy flow of conversion in the form of the two flows through the two independent degrees of freedom.

20. The method according to anyone of claims 18 and 19, in which the third, at least one dependent degree of freedom of rotary motion, can be created in the process of transforming a motion of male and female members and links of synchronizing coupling, and a part of positive energy flow of conversion inside said machine, can be used in transforming a motion through an additional dependent degree of freedom of mechanical rotation of said machine with decreasing the number of independent degrees of freedom per unity.

21. The method according to anyone of claims 18 to 20, in which the angular velocities of said members are determined according to the expression:

$$k_1\omega_1 + k_2\omega_2 + \omega_3 = 0,$$

where:  $\omega_1, \omega_2$  represent the angular speed of the said conjugated elements about their axis;

$\omega_3$  represents the angular speed of the link of synchronizing coupling;

$k_1, k_2$  represent the constant coupling coefficients;

herewith, values of angular velocities of rotation of conjugated elements are defined from expression:

$$(z-1)\omega_1 - z\omega_2 + \omega_0 = 0,$$

where:  $\omega_1$  represents is the angular speed of the member around its axis, enveloping surface of which has the form of curvilinear surface;

$\omega_2$  represents the angular speed of rotation of the member around its axis, enveloping surface of which has a shape of inner or outer envelope of a family of surfaces, formed with the said curvilinear surface;

$\omega_0$  represents the angular speed of the orbital revolution of the axis of the member executing planetary motion;

$z$  represents an integer,  $z > 1$ .

22. The method according to anyone of claims 18 to 21, in which any two of the three rotations can be synchronized between one another, namely, the rotation of one of the conjugated elements about their fixed axis, the revolution of an axis of the member performing a planetary motion with the link of synchronizing coupling and the swiveling of the member with a movable axis.